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OF SPRING WHEAT TO BROWN RUST - Soviet Union

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EFFECT OF POTASSIUM NUTRIENT ON CHANGING THE SUSCEPTIBILITY
OF SPRING WHEAT TO BROWN RUST

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The effect of fertilizers in changing the reaction of wheat to rust has been demonstrated by many workers (1). Potassium fertilizers strengthen their resistance, while nitrogen fertilizers in some dosages increase their susceptibility to the disease. The effect of fertilizers differs depending on the variety and physiological strain of brown rust. This changeability in reaction is clearly displayed by the group of wheats which occupy the intermediate position between the susceptible and resistant varieties. It was of interest to compare this change in reaction for certain varieties of this group to brown rust as affected by the temperature conditions in which wheat is cultivated, a dependence which was noted by us for the first time (2). The flexibility of the reaction to rust, as observed when a variety is subjected to the action of diverse factors of environment, makes it possible to use varieties with resistance acquired with age as indicators for the solution of various questions concerning methods and practice.

The experiment in question is an attempt to obtain a pronounced effect on the reaction of wheat by adding an inorganic nutrient. The following varieties of spring wheat were tested: Lyutetsens 062, acclimatized everywhere; Tulum³-3A-3L, acclimatized to the eastern part of Siberia; Garnet from the Northern zone; and Markiz, occurring within a small area (Azerbaijdzhan, the Caucasus). The first two varieties are known to be susceptible to the action of rust, while the others are varieties with resistance acquired with age, that is, they belong to the group with medium resistance.

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In order to avoid the effect of a complicated set of soil conditions, which would hinder the analysis of the phenomenon being studied, we set up a vegetation experiment (VIZE, 1941) in large Wagner vegetation vessels filled with quartz sand. Hoellriegel's mixture No 1 was placed in the vessels. The trace elements were introduced every 10 days. The crop was produced by planting seeds which had germinated. Fifteen plants were planted per vessel and four repeats were made. It was intended to modify the reaction of wheat by the introduction of potassium and nitrogen fertilizer during the stage of full heading. This period of introduction was chosen for the following considerations: According to our data, in some types, among them Markiz and Garnet, the stability toward rust is changed in the phase of earing, depending on the temperature at which their development in the phase between sprouting and heading takes place. Lowering of the temperature during this period causes increase of resistance, while an increase of temperature brings about a decrease in resistance during the phase of earing. On this we base the assumption that the earing phase may be critical in regard to the shift in the reaction to rust under the influence of other environmental factors as well. The nutrient was administered in the form of 40-percent potassium salt, in normal and in triple doses, and also in the form of ammonium nitrate. The scheme of the experiment was: NPK, NPK + K_1 , NPK + K_2 , NPK + K_3 .

The introduction of the nutrient had no effect on the phenology of the wheat up to the earing phase. Growth and development of the types proceeded evenly in all variations. Artificial infection with the twentieth race of brown rust (from the town of Pushkino) was carried out in the period from 19 20 July, during the phase of earing of all types. A suspension of uredospores was applied with a brush to the leaves of the first and second level. After infection, the experimental vessels with the plants were placed in a damp chamber for 16 hours.

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The temperature was maintained at the optimal level for the further development of the infection. The maximum temperature did not exceed 24°, the minimum temperature went down from 18° in the evening to 12° in the morning.

As a result of the strong development of *Erysiche graminis*, the variation of the experiment with nitrogen nutrient were dropped. For this reason, all variations of the experiment on the Markiz type had to be eliminated and the experiments concluded at the earing stage. The results of the artificial infection are shown in the table.

The qualitative reaction of the type was determined by the Mains-Jackson scale. The total percentage of infected plants was calculated by counting the diseased leaves at the first and second levels. At all three variations of the experiment, the type of reaction of the varieties turned out to be constant and characteristic: type IV in sensitive varieties and type II in varieties with age resistance. The introduction of potassium had an effect on the degree of the infection, in general on the percentage of the diseased leaves and plants in all three varieties. The Tulun ZA-31 variety occupied first place in sensitivity (high degree and percentage of infection), but with a triple dosage of potassium in the nutrient the degree dropped from 3 to 1. The infection dropped to almost half its value with a single dose of potassium. Lyutetsens 062 - a sensitive variety, reacted to the introduction of potassium only by a lowering of the number of plants infected, with the reduction of the infection proportional to the increase of the potassium dosage.

The results of the artificial infection of wheat in the earing phase show, besides, that for the evaluation of a variety ^{for its resistance to} brown rust, the use of one qualitative reaction, i.e. the type of infection, is clearly insufficient. In our case, the type of infection was not changed by the fertilizers introduced, and remained constant and characteristic for the variety. But with increased dosage of potassium nutrient, a change in

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the degree of infection took place (Garnet and Tulun 3A-3L varieties): the greater the degree of infection, the higher the percentage of infection, and vice versa.

In Kozorachev's work [3] the greater effect of spring nutrients as compared to fall nutrients, generally on young plants, is mentioned.

The agreement between field experiments and our data indicates the general regularity of the effect. This provides a basis for the practical application of our conclusions.

Summary

1. The summer wheat varieties Tulun 3A-3L and Lyutetsens 062 from a group of varieties sensitive to rust, and Garnet from a rust-resistant group were investigated. They react to the introduction of potassium by a change of their reaction to brown rust.

2. Potassium introduced in the form of nutrient in the bushing phase of wheat increases the resistance of these varieties in the earing phase upon their infection with race No. 20 of brown rust.

3. The effectiveness of the same quantities of potassium depends on the specific properties of the variety. A sharp increase of the resistance was noted in the Tulun 3A-3L and Lyutetsens 06L varieties upon administration of a normal dose of potassium. In the Garnet variety, the reaction shifted toward high resistance upon the introduction of potassium in a triple dose.

4. The ratios in the dosages of fertilizer, and the times of introduction of the potassium nutrient must be worked out beforehand, in connection with the specific characteristics of the variety, i.e. in agreement with the scope of the variability of its reaction to rust.

5. The evaluation of the degree of infection of the varieties by brown rust according to the qualitative reaction of Mains and Jackson does not reflect the change in the resistance of the above varieties. These changes are determined by quantitative evaluation - by the degree of infection and the per-

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centage of infection. Thus it is essential to use both qualitative and quantitative evaluation of the infection of plants in the late phases of development.

Table

Variety	Fertilizer	Level of leaves, in succession	Degree of infection	Type of infection	Percentage of infection	
					Leaves	Plants
Lyutetsens 062	NPK	I	0-1	IV	67.5	72.5
	BrK	II	0-1	IV	40	
	NPK + K ₁	I	0-1	IV	42.5	62.5
	NPK + K ₁	II	0-1	IV	27.5	
	NPK + K ₃	I	0-1	IV	22.5	47.5
	NPK + K ₃	II	0-1	IV	25.0	
Carnet	NPK	I	0-1	II	20.0	20.0
	NPK	II				
	NPK + K ₁	I	2	II I	25.0	20.0
	NPK + K ₁	II			17.5	
	NPK + K ₃	I	0-1	II	2.5	12.5
	NPK + K ₃	II			10.0	
Tulun ZA-31	NPK	I	3	IV	70.0	90.0
	NPK	II	2	IV	70.0	
	NPK + K ₁	I	2	IV	57.5	-
	NPK + K ₁	II			-*	
	NPK + K ₃	I	1	IV	52.5	52.5
	NPK + K ₃	II			-*	

*) The percentage of infected leaves is not given, since the strong Erysiphe graminis infection masked the rust infection.

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